Please complete and return to:

NERC Field Spectroscopy Facility
Grant Institute
School of GeoSciences
University of Edinburgh
West Mains Rd
Edinburgh, EH9 3JW

For Official use only

Date received: _____

Application number: _____

Alpha rating: _____

ARSF supported: _____

It is a condition of loan that all applicants are expected to present the results of their research at the FSF Users meeting, and all publications arising as a direct result of your loan should fully acknowledge the support of the facility. Failure to do so may jeopardise future loans.

1. Principal Investigator (P.I.) / Applicant

Name of PI: **Dr Ellie Highwood**

Status/job title: **Lecturer**

Address: **Department of Meteorology, University of Reading, Reading.**

Post code: **RG6 6BB**

Telephone:

Email:

2. User (if different from applicant)

User (if different from PI):

Status/job title:

Address:

Post code:

Telephone:

Email:

3. Equipment and measurements.
Please select the instrument(s) you wish to borrow and indicate what types of measurements you will be making. Detailed information regarding instrument specifications is available on our website at http://fsf.nerc.ac.uk

Instrument	Wavelength range	
ASD FieldSpec Pro	350 - 2500 nm	☐
GER3700	350 – 2500 nm	☐
GER1500	350 – 1100 nm	☐
GER1500 dual FOV	350 – 1100 nm	☐
Microtops II	Sun photometer	☒

Types of spectroradiometer measurement

Reflectance ☐

Radiance ☐

Irradiance ☐

4. Is training required? (NB if the person USING the equipment has NOT already been trained by FSF, then attending a training course in Edinburgh is compulsory). We provide fully customised, one-to-one training courses tailored to individuals' needs. We also offer refresher courses for those who have not used the equipment for over 18 months, or if requested.

YES ☐ NO ☒ Refresher course ☐

5. Period of Loan Dates when equipment is required (inclusive)

1st choice **18th Aug – 13th Sept 2004** 2nd choice

6. Research Project Title (maximum of 12 words)

Aerosol Direct Radiative Impact EXperiment (ADRIEX)

7. Proposed site(s) (Please provide latitude and longitude or national grid area)* **Treviso (45°40'N, 12°15'E) and Venice (45°27'N, 12°21'E), Italy**

8. Other personnel involved in project (please provide names, affiliation and status)

- **Jim Hayward, Aircraft Scientist and Business Manager. Met office.**
- **University of Oslo, Norway**

9. Funding type. *Please note that loan priority will be assigned to those projects currently in receipt of a NERC Grant or studentship*

a. Project funding

NERC Research Grant (specify in section **c**)	NERC other (specify in section **c**)	Other academic (please specify below)	Other (please specify below)
☐	☒	☒	☒

Other academic: University of Oslo, University of Leeds, and Royal Society grant

Other: Met. Office

b. User/studentship funding

NERC studentship (including NERC CASE or tied studentships)	Other studentship	No associated studentships
☒	☐	☐

c. NERC funding details. If in receipt of NERC funding please provide the full grant or studentship reference number and the title of the project

- **NERC / Met. Office CASE studentship**
- **Supported by the NERC Facility for Atmospheric and Airborne Measurements**

10. Science areas

a. Please indicate which ONE of the following science area is the most fitting for your application.

Atmospheric	☒	**Earth Observation**	☐
Earth	☐	**Science Based Archaeology**	☐
Marine	☐	**Polar**	☐
Terrestrial & freshwater	☐		

b. Please indicate which NERC Science Priority Area is the one most relevant to your requested loan.

Earth's life support systems – water, biogeochemical cycles and biodiversity	☐
Climate change – predicting and mitigating the impacts	☒
Sustainable economies – identifying and providing sustainable solutions to the challenges associated with energy, land use and hazard mitigation	☐
Underpinning science - used mainly when expenditure relates to the funding categories infrastructure, specialist major infrastructure or major capital projects	☐
Specific research - research on science NOT impacting on the first three priority areas	☐

11. ARSF applications

If this application is in association with an Airborne Remote Sensing Facility (ARSF) proposal, please provide the ARSF reference number, PI name, project title, requested flight dates and grade below.

ARSF Application Number: **N/A**

*Please note that if you wish to take the equipment out of the UK during your loan you should provide further justification for your choice of site in section 9. EPFS staff will be able to advise on customs issues, and will provide essential paperwork for your trip, but export and import will be the sole responsibility of the P.I. in charge of the project.

Principal Investigator:

Full Title of ARSF Project:

Requested Flight Dates: Grade:

12. Previous FSF loans

a. Is this application associated with any previous applications to FSF? If so please provide the loan reference number(s), the name(s) of the Principal Investigator(s), and the grade(s) of each.

b. Please list the outputs from your previous loan(s), in terms of publications, presentations etc?

13. Research Programme: Scientific background to your proposal

Please use the space below to give details of the scientific aims and objectives of the project. Please describe in full the purpose of the study and why it is important. You should place the study in the wider scientific context, and cite related work from the published literature. Make sure you provide adequate justification for how field spectroscopy will contribute to your research. Details of how the science you intend to undertake will contribute to scientific knowledge, and how it will fit with the aims of the NERC Strategy "*Science for a Sustainable Future*" should also be included. If your research will be conducted overseas you should provide justification for taking the equipment abroad.

Science Case:

Background and motivation

Aerosol can drastically affect regional climate. Some types of aerosol scatter solar radiation back to space whilst others absorb solar radiation, heating up layers of the atmosphere. There can also be impacts on the surface energy budget and therefore on the hydrological cycle. Anthropogenic aerosol, arising from fossil fuel burning and other industrial processes, is a complex cocktail of different kinds of particles and droplets. Its effect on climate depends critically on the type of aerosol, how it is mixed together, the nature of the underlying surface and the presence of clouds. These uncertainties prohibit accurately modelling the impact of such aerosol on climate. It is necessary to measure the aerosol physical and chemical properties and the radiation fluxes in the region of the aerosol using a combination of in-situ observations and remote sensing.

One of the major sources of aerosol affecting Europe is the Po Valley in Italy where the orography and meteorology conspire to allow the build-up of persistently high aerosol concentrations. The measurement campaign (Adriatic) Aerosol Direct Radiative Impact EXperiment (ADRIEX) has been co-funded by NERC and the Met. Office to perform the physical, chemical and radiative measurements needed to determine the size and sign of the impact of this aerosol on climate. The campaign will take place during August and September 2004 and will result in a large amount of novel data (including from an Aerosol Mass Spectrometer provided by UMIST) which will be analysed in a variety of ways in collaboration with the Met. Office. It will lead to better understanding of the radiative and physical properties of the aerosols, and indicate the way to improve representation of aerosol in this region in climate models.

Project Aims and Expected Outcomes

The proposed loan of Microtops instrumentation will:

- Provide ground based spectral measurements for use in radiative closure studies involving the in-situ aircraft data and radiative transfer models.

This will contribute to the key aims of ADRIEX which are

- To perform high quality in-situ and remote sensing measurements of the optical and physical properties of anthropogenic aerosol from Eastern and Western pollution sources.
- To perform radiative closure studies investigating the consistency between measured/modelled radiances/irradiances from a variety of platforms e.g. aircraft, surface based sun-photometers and satellites
- To determine the direct radiative forcing of anthropogenic tropospheric aerosols and gases such as tropospheric ozone and methane.

:

This work will inform the next report of the Intergovernmental Panel on Climate Change as well as producing several research papers in a special issue dedicated to the ADRIEX campaign. The results will feed in to the development of remote sensing methods for aerosol and to the development of aerosol schemes for regional and global climate models. The proposed research is highly relevant to NERC strategic areas of climate change and the Earth's life support systems in terms of biogeochemical cycles and hydrological cycles.

14. Research Programme: Proposed Methodology

Please use the space below to provide details of the project methodology. This section should include details of how data will be collected and analysed, how the spectral data will contribute to the project and whether the spectral data will be related to other parameters (and if so what other parameters).

Methodology:

The ADRIEX project includes in-situ measurements using the FAAM aircraft with its suite of radiation and aerosol instrumentation, a CIMELS sunphotometer courtesy of TNL, and a portable Lidar. We also carry the Aerosol Mass Spectrometer and filters, as well as some gas phase chemistry instrumentation. The Lidar and TNL CIMELS will be based at Venice Lido airport, whilst the aircraft will be based in Treviso. We also plan to overfly AERONET sites at Venice and in Rumania, and are co-ordinating flying with satellite overpasses by MODIS, HIRDLS and AATSR.

The additional Microtops requested here will be based at Treviso and the Lido and will provide high quality data with the benefit of being able to avoid scattered cloudy periods (the CIMELS will not be able to be selective in this way).
Stacked profiles and series of straight and level runs at different altitudes will be flown close to the sites to characterise the aerosol. The sunphotometers requested can provide an independent measurement of aerosol optical depth and can be more flexible than the CIMELS instrument.

After the campaign, the Microtops data will be used to provide independent measures of aerosol optical depth for comparison with aircraft, satellite and modelling estimates.

15. Your publication record

Please provide details of your publication record from the past five years in the space provided below. All publications are important, including conference proceedings, reports and poster papers. Those articles which are not directly related to remote sensing or field spectroscopy should also be listed. Please use the additional sheet at the back of the application form if you require more space.

Publication Record:

1. Shine KP, Cook J, **Highwood EJ,** Joshi MM 2003: Alternative to radiative forcing for estimating the relative importance of climate change mechanisms Accepted by Geophys. Res. Lett. .pdf version
2. Cook, J. and **E.J. Highwood** (2004) Climate response to tropospheric aerosols in an Intermediate General Circulation Model Accepted, Q.J.R.M.S.
3. Abel, S.J., J.M. Haywood, E.J. Highwood, J. li and P. Buseck (2003) Evolution of aerosol properties from biomass burning measured during SAFARI2000 Geophys. Res. Letts., 30, doi:10.1029/2003GL017342. .
4. Grainger, R.G., and **E.J. Highwood** (2003): Changes in stratospheric composition, chemistry, radiation and climate caused by volcanic eruptions. In "Volcanic degassing: Special publication of the Royal Geological Society, 213, Eds C. Oppenheimer, D. Pyle and J. Barclay. London.
5. Haywood, J.M, P. Francis, S. Osborne, M. Glew, N. Loeb, **E.J. Highwood**, D. Tanre, G. Myhre and P. Formenti. (2003) Radiative properties and direct effect of Saharan dust measured by the C-130 aircraft during SHADE. 1. Solar spectrum. J. Geophys. Res.,108,8577, doi:10.1029/2002JD002687.
6. **Highwood, E.J.**, J.M. Haywood, M.D. Silverstone, S.M. Newman and J.P. Taylor (2003) Radiative properties and direct effect of Saharan dust measured by the C-130 aircraft during SHADE. 2. Terrestrial spectrum. J. Geophys. Res., 108, 8578, doi:10.1029/2002JD002552.
7. Tanre, D, J. Haywood, J. Pelom, J.F. Leon, B. Chatenet, P. Formenti, P. Francis, P. Goloub, **E.J. Highwood** and G. Myhre (2003) Measurement and modelling of Saharan dust radiative impact: overview of the SaHAran Dust Experiment (SHADE). J. Geophys. Res., 108, doi:10.1029/JD2002003273.
8. Stevenson, D., C. Johnson, **E.J. Highwood**, V. Gauci, W. Collins and R. Derwent (2003) Atmospheric impact of the 1783-1784 Laki eruption: Part 1 Chemistry modelling. Atm. Chem. Phys., 3, 487-507.
9. **Highwood, E.J.** and D. Stevenson (2003) Atmospheric impact of the 1783-1784 Laki eruption: Part 2 Climate effect of sulphate aerosol. Atm. Chem. Phys.,3, 1177-1189.
10. Shine, K.P. and **E.J. Highwood** (2002) Problems in quantifying natural and anthropogenic perturbations to the Earth's energy balance. In "Meteorology at the Millennium", International Geophysics Series Volume 83, Edited by R.P. Pearce.
11. **Highwood, E.J.** (2000) Effect of cloud inhomogeneity on direct radiative forcing due to aerosols. Journal of Geophysical Research., 105, 17842-17852.
12. **Highwood, E.J.**, B.J. Hoskins, and P. Berrisford, (2000) Properties of the Arctic tropopause . Quarterly Journal of the Royal Meteorological Society, 126, 1515-1532.
13. **Highwood. E.J.**, and K.P. Shine,(2000) Radiative forcing and global warming potentials of 11 halogenated compounds . Journal of Quantitative Spectroscopy and Radiative Transfer., 66, 169-183.

16. What output is expected from the research? (Please indicate expected output types and time scales)

- Presentation of initial results at post-campaign meeting December 2004
- Publication of results in special section of Quarterly Journal of the Royal Meteorological Society: submission during Easter 2006

17. Declaration

I have read and agree to abide by the Conditions of Loan.

Signature of Applicant _____ Date _____

Signature of Head of Department or Institute Director _____ Date _____

18. Please use the additional space provided for adding further information you feel may support your application

Further information: